as against 850 in Mauritius. The larger number may be accounted for by the greater elevation of Bourbon, as well as the divergencies in the numerical representation of the predominating natural orders. Some fourteen fewer natural orders are represented in Bourbon, but, in return, several orders are much more numerously represented.

It was known that Bourbon, as well as Mauritius, was exceedingly rich in ferns and orchids; yet few botanists will be prepared for the fact that orchids outnumber the two next highest orders combined. Orchids are absent or very rare in small remote islands, and comparatively rare in larger ones where there is a humid climate and rich vegetation; or even absent, Juan Fernandez, for example; and British India is the only large continental area, so far as I am aware, in which orchids predominate over any other order. Nearly 20 per cent. of the flowering plants of Bourbon are orchids; the total number described being 172 species, and the author expresses a doubt whether this is exhaustive. Three new genera are proposed, one, *Hemiperis*, comprising twenty-one species. Altogether seventy-two are described as new, and they are about half epiphytic and half terrestrial. Very few of these orchids are represented in the herbaria of this country, and, indeed, many of the other endemic plants of the island, especially the inconspicuous ones.

Dr. Cordemoy describes three or four new genera belonging to other orders, but mostly from somewhat imperfect materials. The most interesting is a labiate (*Mahya stellata*), supposed to be the only really indigenous member of the order, and exceedingly rare, being found only on the summit of the Grand Benard, at about 8500 feet.

W. BOTTING HEMSLEY.

TECHNICAL EDUCATION.

The New Technical Educator. Vols v. and vi. (London, Paris, and Melbourne: Cassell and Co., Limited, 1895).

THESE are the concluding volumes of a valuable series of treatises on various technical subjects; the previous ones have already been noted in our columns. All the subjects are dealt with in an admirable manner, the author in each case being a specialist. The arrangement of the work is such that in most cases each volume contains information bearing upon a particular subject. A good index has been placed at the end of the last volume, and this very materially adds to the value of the work.

Prof. W. H. Greenwood's treatment of the manufacture of "Steel and Iron" is excellent. Commencing with the ores, he takes the reader through all the many processes in vogue, with ample illustrations and descriptions. The question of tests, however, appears to be generally overlooked. This is unfortunate, because it is of great importance both to the manufacturer and the engineer. In all modern specifications the quality of the material to be used is always stated, either in the form of mechanical or chemical tests.

Another well-written section is that on "the Steam Engine," by Archibald Sharp. In this case, also, the subject has been thoroughly dealt with from the beginning. The illustrations and descriptions are of recent engines, and boilers. Of the latter, the water-tube type has not been overlooked; more might have been said, however, on the subject. The locomotive is represented by one of Mr. Worsdell's compounds, and we are told that "compound locomotives are being largely used." This statement is scarcely correct, because in this country, at any rate, they are at a discount. The same author has much to say on the subject of "Gas and Oil Engines." He omits to describe the porcelain ignition tubes now largely used in place of iron.

On "Engineering Workshop Practice," by severa authors, we find much general information dealing with the engineering trades. Taken as a whole, the treatment flavours more of the amateur than of the tradesman. The same cannot be said of "Electrical Engineering," by Edward A. O'Keeffe, because this subject occupies a prominent position in these volumes, having been particularly well written throughout. The last two volumes treat more particularly of the construction of incandescent lamps, accumulators and measuring instruments, concluding with descriptions of the microphone, telephone and phonograph, besides sundry details.

"Civil Engineering" has also been creditably treated from all points of view, the construction of roads naturally coming much to the front, and the praises of Telford and Macadam duly sung. An interesting account is included on the rise and progress of railways; when discussing probable speeds, we read: "The desire is now for higher speeds, and as much as 250 miles per hour is projected." This statement is far-fetched, and should have been omitted. The table giving train resistances, on p. 175, vol. v., would have been of more value had the authority been quoted. Further on, permanent way is discussed, and we are informed that "sleepers are never placed under the fish-joints." This statement is not correct. Another inaccuracy is found on page 297, where we read "that the driving-wheels of some locomotives have as much as twenty-five tons on them"; even the Great Northern people would probably plead "not guilty" to twenty tons on the driving-wheels of their famous single engines. Much useful information has been brought together under the heads of hydraulics, pumping machinery, lighthouses, ships, &c.

The "Dyeing of Textile Fabrics" is fully discussed, the author being Prof. J. J. Hummel, of the Yorkshire College; treated very much from a chemical point of view, dyers will find much to learn on this subject. In answer to the question, "What is technical education?" we find some sound remarks from the pen of Mr. Henry Cunynghame. He observes that the use of a knowledge of principles, as compared with the mere routine of the workshop, cannot be overrated; this is the distinguishing feature of the true mechanic from the factory hand. Much has been done of late years to encourage the formation of technical schools; but more must be done if we are to retain our present position as a manufacturing country. A knowledge of principles, both mechanical and chemical, is all-important; and these, in conjunction with machinery of the latest design, must surely tell in the race for trade.

The volumes before us will be of much use to those

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wishing to study any of the subjects dealt with in this "Encyclopædia of Technical Education." The treatment is thorough, the illustrations numerous, and the printing good. N. J. L.

OUR BOOK SHELF.

A Laboratory Course in Experimental Physics. By W. J. Loudon, B.A., Demonstrator in Physics in the University of Toronto, and J. C. McLennan, B.A., Assistant Demonstrator in Physics in the University of Toronto. Pp. vi + 302. (New York and London: Macmillan and Co., 1895.)

THIS book, the authors tell us in the preface, is the outcome of their own experience, and is intended, in the first instance, to be used by the students at the University of Toronto, and the hope is expressed that it will be appreciated by those engaged in teaching experimental physics elsewhere.

The book is divided into two parts. Part i. is devoted to the description of elementary apparatus and elementary methods of performing simple experiments in mechanics, light, photometry, and heat. In this part students are only expected to be acquainted with the elements of algebra and trigonometry. On p. 55 is given a very neat elementary proof of the fact that the deviation of a ray of light passing through a prism is a minimum when its direction is symmetrical with respect to the refracting surfaces. We think that, considering how elementary this part is, the explanations might at times be simpler. It is not wise to indulge too frequently in such expressions as "it can be readily seen," even in matter intended for advanced students; and teachers cannot be too lucid when dealing with beginners.

Part ii. is intended for advanced students, and contains directions for experiments in acoustics, heat, electricity, and magnetism, with an appendix on the determination of gravity and on the torsion pendulum. The theory of the various experiments is given, and demands a wider mathematical knowledge, *e.g.* the laws of the transverse vibrations of strings are deduced from the equations of motion. A striking omission in this part is the little attention which is given to the corrections which have to be applied when making most accurate physical measurements.

The choice of experiments is good, the theory and descriptions of the apparatus are accurate, and the illustrations are clear. The division into elementary and advanced is not apt, as many of the experiments in Part ii. would be more suitably placed in Part i. This, however, is not a serious defect, as teachers using the book can arrange the order of the experiments to suit themselves. We certainly think that students of physics should become acquainted with the simpler electrical experiments as early as possible.

The book is well got up, and its value is greatly enhanced by the tables of physical constants at the end. We heartily recommend the work to teachers of practical physics as containing very good matter, and being accurate and free from misprints. W. G. RHODES.

The Natural History of "Eristalis tenax," or the Drone-fly. By G. B. Buckton, F.R.S. Pp. iv + 92. With illustrations. (London: Macmillan and Co., 1895.)

THE author's solid contributions to more than one branch of science may well protect him from criticism of extreme severity, but it is our duty to remark that this is not an adequate account of the drone-fly. The subject is a particularly good one. The drone-fly is very common, large for a dipterous insect, and distinguished by many interesting peculiarities of structure and habit. But the author has not realised how much work goes to the production of an exact and thorough monograph. Such a monograph demands minute investigation of the anatomy of every stage, comparison with some few allies at least, and much patient observation of the living insect. Mr. Buckton has not worked out the anatomy of the drone-fly in any stage, as the vague figures testify. Some important and very peculiar features of the larva are passed over without mention. There is no effective comparison with other insects. The habits of the larva and the fly have been attended to, and the account of the mode of life of the fly contains the only valuable facts in the book. There is much matter concerning insects in general, but this is not always either trustworthy or pertinent. Sometimes facts and theories are cited, not from the original memoirs, but from any author who happened to be at hand. Weismann on *Corethra* is quoted from Balfour, Johnston on *Culex* from Riley, Müller on mosaic vision from Mallock. The danger of this practice is illustrated by the last case, where Mr. Buckton shows that he is not fully possessed of the theory of mosaic vision. It may be useful to remark that the larvæ and egg-chains mentioned on page 19 probably belong to the very familiar *Chironomus*. The drone-fly has been studied by our author as a hobby, and he has no doubt got much pleasure out of it; but a more serious attack should be made upon it before long. L. C. M.

Working Models for Engineering Students. Engine Slide-Valves. Designed by Messrs. T. Jones, M.I.Mech.E., and T. G. Jones, B.Sc. Second edition. (Manchester: John Heywood, 1895.)

TO obtain a thorough insight into the movements of slide-valves, and to completely understand the distribution of steam, is generally a difficult matter to first-year students and engineering apprentices. These models, however, should greatly assist all who study the subject; they are neatly printed on cardboard, the important parts are sectioned and tinted, and the valves are movable so as to show their positions when the piston is at any part of the stroke. The relative positions of crank-pins and eccentrics are clearly shown, as well as the valves and steam-ports. The models are of a convenient size, being six inches long by four inches wide, and they represent eight different kinds of slide-valves. As such models must be absolutely accurate from a mechanical point of view to be of use to technical students, we must point out that No. 1 is said to represent a slide-valve common in locomotive practice; but the valve spindle is shown passing through the valve, whereas valve buckles are always used. No. 2 is a single-acting piston valve for a steam hammer. If it is considered necessary in this case to show the piston and rod, why not do it accurately? The parts shown do not represent a steam-hammer piston and part of the rod.

Model No. 5 represents a partly-balanced ordinary slide-valve. The authors omit to say that the space inside the relief ring must be open to the exhaust cavity to allow any steam leaking past the ring to escape, otherwise it would be of no good. This type of valve is now being largely used for locomotive purposes. The same defect is to be found in model No. 7.

Taken as a whole, the models are very useful for the purpose of illustration; they will be of much value to students and others interested in the subject.

Macmillan's Geography Readers. Book vii. Pp. 240. (London: Macmillan and Co., 1895).

IN this little Reader for elementary schools, instructive descriptions are given of the chief places and objects of interest to be seen in a journey through the United States; and the main historical facts concerning the New World are woven into the lessons, to give them additional brightness. The book also contains sections on ocean currents and tides, and is well illustrated; while the numerous extracts from the writings of travellers, give a good idea of the conditions and characteristics of American people.

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